

Incidence of Wood Borer Activity

IN GREEN ASH WINDBREAK PLANTINGS IN NORTH DAKOTA



U. S. DEPARTMENT OF AGRICULTURE – FOREST SERVICE
DIVISION OF STATE AND PRIVATE FORESTRY



Region One
Missoula, Montana

INCIDENCE OF WOOD BORER ACTIVITY
IN GREEN ASH WINDBREAK PLANTINGS IN NORTH DAKOTA

by

Scott Tunnock and Arden Tagestad^{1/}

ABSTRACT

An evaluation was made during midsummer 1972 to measure damage by the carpenterworm, *Prionoxystus robiniae*, and the ash borer, *Podosesia syringae*, to green ash in windbreaks in North Dakota.

Intensity of infestation was determined in four land resource areas and four age classes of windbreaks. Of the 96 windbreaks examined Statewide, the ash borer was present in 51 percent and the carpenterworm in 28.1 percent. The carpenterworm predominated in trees older than 16 years, and the ash borer was more prevalent in trees under 15 years old. Damage by borers was greatest in the southwestern quarter of North Dakota where the carpenterworm had attacked 23.4 percent of the trees and the ash borer 7.2 percent. Damage by borers was negligible in the remainder of the State.

The carpenterworm can be considered a minor problem in the eastern half of North Dakota. However, the presence of the ash borer in more than half the windbreaks sampled Statewide makes this insect a potential threat to their management. Control measures are available and should be applied where owners are concerned.

INTRODUCTION

Farmstead windbreaks and field shelterbelts are important components of the otherwise treeless regions of North Dakota. They aid in preventing top soil from being blown away, break the wind around homes and ranch buildings, and provide shelter for wildlife.

Green ash, *Fraxinus pennsylvanica* Marsh, is a highly desirable tree species for windbreaks. It is relatively fast growing and wind resistant because of its strong wood. However, damage (fig. 1) by two species of wood borers, the carpenterworm, *Prionoxystus robiniae* (Peck) (fig. 2), and the ash borer, *Podosesia syringae* (Harris), has

^{1/} Respectively, entomologist, Division of State and Private Forestry, Northern Region, USDA Forest Service, Missoula, Montana; and biological technician, Shelterbelt Laboratory, Rocky Mountain Forest and Range Experiment Station, Bottineau, North Dakota.



Figure 1.--Carpenterworm damage to the trunk of a green ash tree. Notice tunnels in the cambium layer and outer wood.

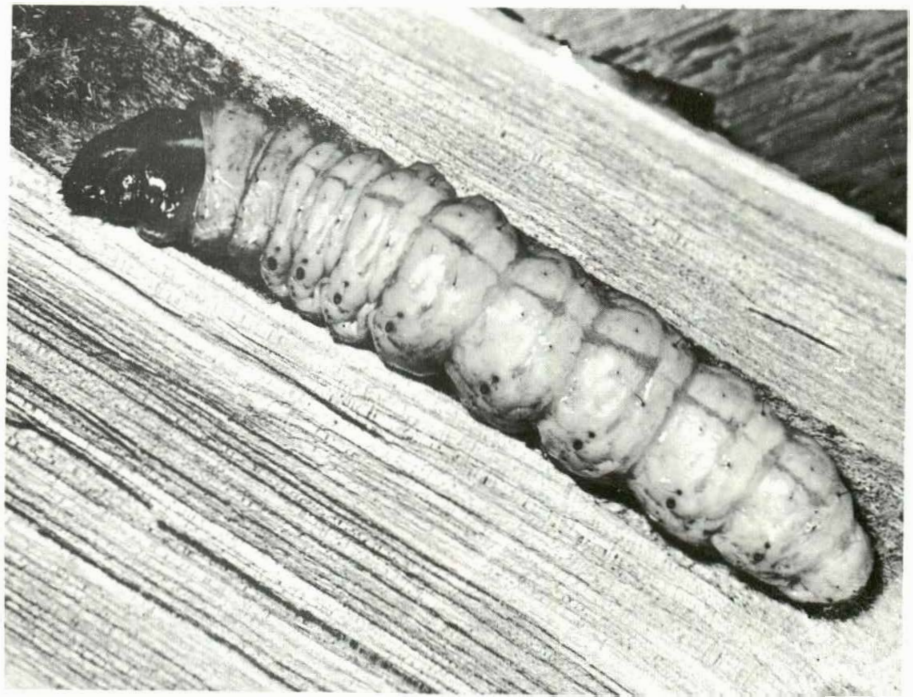


Figure 2.--An almost full-grown carpenterworm larva inside its tunnel.

restricted its use as a windbreak tree in some parts of North Dakota. Lack of well adapted tree species which can be recommended to land-owners for use in windbreaks is of concern to the Soil Conservation Service, the North Dakota Extension Service, and the North Dakota Association of Soil Conservation Districts.

McKnight (1971) reported that the carpenterworm and the ash borer were widely distributed throughout North Dakota and urged an evaluation of their abundance and impact on windbreaks. This survey was made to fulfill the following objective: Determine the intensity of infestation and injury of the ash borer and the carpenterworm in selected windbreaks by age class and major land resource areas in North Dakota.

METHODS

Land Resource Areas

The Soil Conservation Service provided background data on candidate windbreaks in four major land resource areas based on land use, soils, and climatic factors as defined by Austin (1965) (fig. 3):

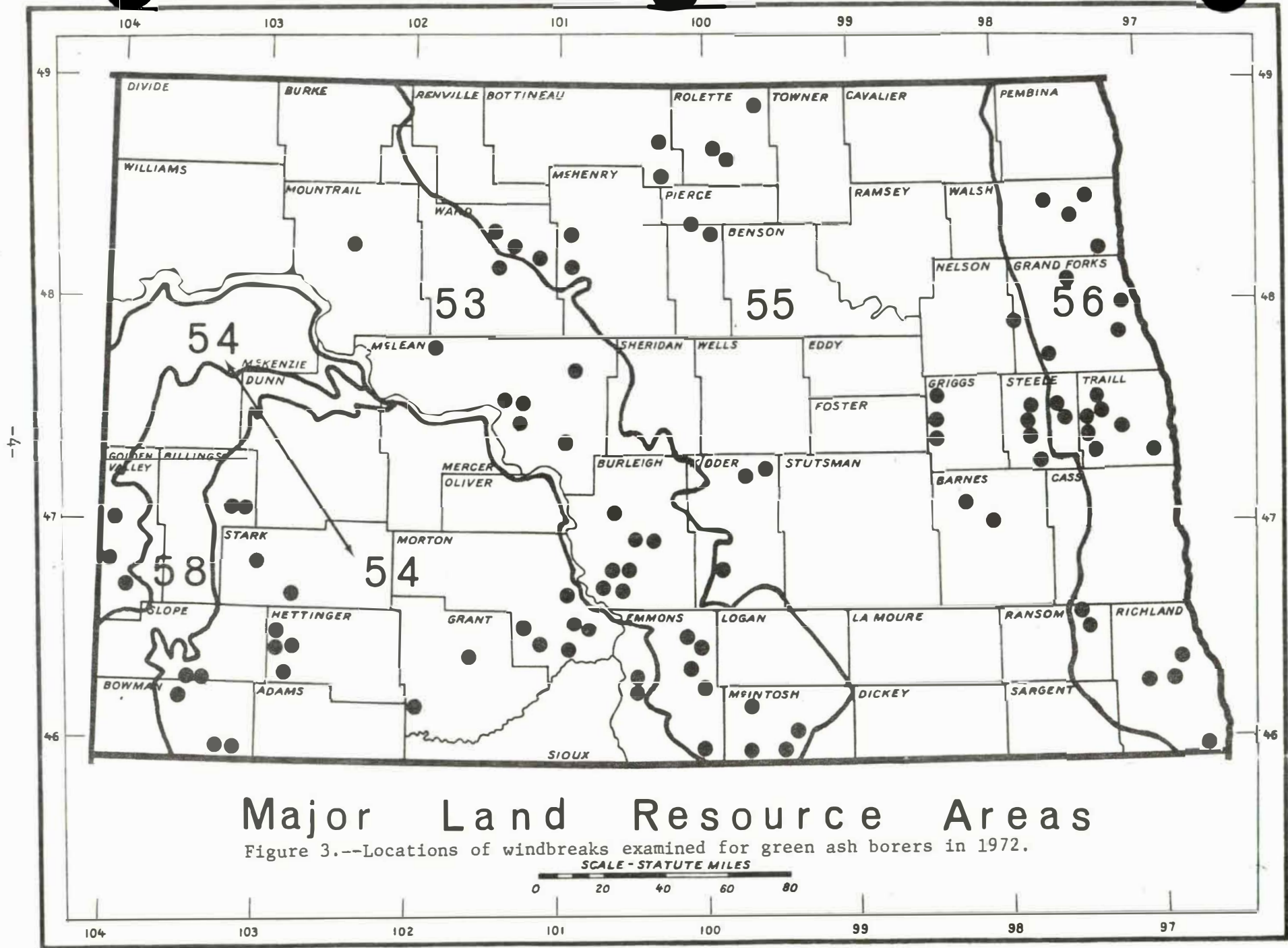
- 53 - Dark brown glaciated plain.--west central portion.
- 54 - Rolling soft shale plain.---southwestern portion.
- 55 - Black glaciated plain.--east central portion.
- 56 - Red River Valley of the North.--eastern portion.

Age Classes

Four age classes of windbreaks were sampled:

<u>Age</u>	<u>Years planted</u>	<u>Types of plantings</u>
0-6	1966-1972	Many single-row, some multiple-row field windbreaks; farmstead plantings; Corps of Engineers recreational plantings.
7-15	1957-1965	Few single-row plantings; many multiple-row field and farmstead plantings; wildlife plantings (wide); Corps of Engineers plantings.
16-30	1942-1957	Multiple-row field and farmstead plantings.
31 and older	Prior to 1942	Prairie States Forestry Project plantings (USFS); Timber Claim Act plantings.

NORTH DAKOTA



Whenever possible, six windbreaks in each age class were sampled in each of the four land resource areas. A total of 96 windbreaks were examined.

Selection of Sample Trees within Windbreaks

Sample trees within a windbreak were selected by systematic sampling. Sample size was based on an assumed mean infestation level of 20 percent and an allowable error of ± 10 percent of the true percentage of trees infested.

The size of the population to be sampled (N) in a windbreak was estimated from planting records. The number of trees to be examined (n) in a population was computed from a standard formula (table 1).

To select trees to be examined from a population of N trees, the first sample tree was drawn at random from $K = N/n$ trees and every Kth tree was examined thereafter (table 1). For example, if 20 trees out of 100 were to be examined, then $K = 100/20 = 5$. A random number between 1 and 5 was picked; i.e., 2, and trees 2, 7, 12 . . . 97 were examined.

Variables Recorded for Each Windbreak

The following variables were recorded for each windbreak:

1. Location
 - a. Land resource areas: 53, 54, 55, 56
 - b. County
 - c. Section, township, range
2. Age class: 0-6, 7-15, 16-30, 31+
3. Year planted
4. Owner or operator
5. Type of planting
6. Number of green ash trees planted

Individual tree data was collected as follows:

1. Insect attack
 - a. Carpenterworm (old and new attacks)
 - b. Ash borer (old and new attacks)
 - c. Other borers
 - d. Uninfested.
2. Tree attributes
 - a. Total height
 - b. Growth rate (rings per inch)
 - c. Crown length
 - d. Diameter at base
 - e. Woodpecker activity

Table 1.--Number of trees to be sampled and sampling interval by length of windbreak

$d = .10 \times = 0.05$ estimated percent infestation = .20

<u>Length of windbreak (1/20 mi. increments)</u>	<u>Est. No. trees (N)</u>	<u>Sample size (n)</u>	<u>Sample interval (K)</u>
1	44	26	2
2	88	37	2
3	132	43	3
4	176	47	4
5	220	50	4
6	264	52	5
7	308	53	6
8	352	54	7
9	396	55	7
10	440	56	8
11	484	57	8
12	528	57	9
13	572	58	10
14	616	58	11
15	660	58	11
16	704	59	12
17	748	59	13
18	792	59	13
19	836	60	14
20	880	60	15

Length of windbreak
(1/16 mi. increments)

1	55	30	2
2	140	41	3
3	165	46	4
4	220	50	4
5	275	52	5
6	330	54	6
7	385	55	7
8	440	56	8
9	495	57	9
10	550	57	10
11	605	58	10
12	660	58	11
13	715	59	12
14	770	59	13
15	825	59	14
16	880	60	15
24	1,320	61	22

3. Incidence of permanent injury
 - a. Tree dead
 - b. Mortality of main stem with sprouting
 - c. Branch dieback
 - d. Wind breakage
 - e. Decay

The Soil Conservation Service provided the basic information on individual windbreaks and from these, candidate windbreaks were chosen for sampling. The survey was made during mid-July and August 1972.

RESULTS

During the survey, 4,096 green ash trees were examined in 96 windbreaks within four land resource areas (fig. 3) in North Dakota. Tables 2 and 3 show the proportion of trees and windbreaks attacked by borers in each area. More trees were attacked by borers in area 54 (southwestern portion of the State) than the other three areas (table 2). The carpenterworm had attacked 23.4 percent, the ash borer had attacked 7.2 percent (including old and new attacks), and other borers had attacked 1.4 percent of the trees examined in area 54. Of all the trees examined, 7.2 percent were attacked by the carpenterworm, 3.5 percent were attacked by the ash borer, and 1.2 percent had been attacked by other borers.

The ash borer was present in 51 percent of the 96 windbreaks examined throughout the State. A higher percentage of the windbreaks in area 54 were damaged by borers than in the other three areas (table 3). The carpenterworm was present in 53.8 percent of the windbreaks in area 54; the ash borer in 84.6 percent; and other borers in 26.9 percent.

Both borers were present in all age classes. The ash borer predominated in trees up to 16 years old; the carpenterworm in trees 16 years old and older (table 4). The incidence of carpenterworm infestations increased sharply in windbreaks 7 years old and older; ash borer infestations persisted at a high level in windbreaks up to 30 years of age; and other borers were most prevalent in trees and windbreaks over 31 years old (table 5).

Damage caused by borers other than the carpenterworm and the ash borer was noted in all land resource areas sampled (table 3). Like the carpenterworm and the ash borer, the other borers were most frequently encountered in area 54. They were especially abundant in windbreaks and trees over 30 years of age (tables 4 and 5). The identity of the other borers is not known in all instances, but adults and larvae of a round-headed wood-boring beetle, identified as *Tylonotus bimaculatus* Hald. (Coleoptera: Cerambycidae) were found in living, apparently healthy trees in windbreaks in areas 53, 54, and 55.

Table 2.--Percentage of sample trees attacked by borers in
four land resource areas in North Dakota, 1972

Land resource area	No. trees examined	Trees containing carpenterworm attacks			Trees containing ash borer attacks			Trees w/other borers	Total trees attacked by borers	Trees dead and attacked by borers	Trees w/dead leaders but sprouting and attacked by borers
		Attacks			Attacks						
		Old	New	Total trees	Old	New	Total trees				
		---	---	---	---	---	Percent	---	---	---	---
53	952	1.2	1.1	2.1	1.3	1.8	2.2	1.4	5.5	0.1	0.2
54	1,117	20.8	7.3	23.4	3.3	4.5	7.2	1.4	29.1	3.6	7.9
55	1,044	.4	0	.4	1.1	1.9	2.5	.9	4.0	.1	0
56	983	1.0	.3	1.0	.9	1.1	1.8	1.0	3.5	.1	.3
All	4,096	6.3	2.3	7.2	1.7	2.3	3.5	1.2	11.0	1.0	2.3

Table 3.--Percentage of examined windbreaks damaged by borers in four land resource areas in North Dakota--1972

Land resource area	Number of windbreaks examined	Damaged by		
		Carpenter- worm	Ash borer	Other borers
		- - - - -	Percent	- - - - -
53	23	43.5	34.8	17.4
54	26	53.8	84.6	26.9
55	24	8.3	50.0	20.8
56	<u>23</u>	<u>4.3</u>	<u>30.4</u>	<u>13.0</u>
All	96	28.1	51.0	19.8

Table 4.--Percentage of sample trees in four age classes attacked by borers in North Dakota, 1972

Age class, <u>years</u>	Number of trees <u>examined</u>	<u>Attacked by</u>		
		<u>Carpenter-</u> <u>worm</u>	<u>Ash</u> <u>borer</u>	<u>Other</u> <u>borers</u>
- - - - - Percent - - - - -				
0-6	1,009	0.5	4.7	0.1
7-15	954	3.0	5.8	.2
16-30	1,045	14.1	3.0	.5
31+	1,088	10.4	1.1	4.0
All	4,096	7.2	3.5	1.2

Table 5.--Percentage of examined windbreaks in four age classes damaged by borers in North Dakota, 1972

Age class, <u>years</u>	Number of windbreaks <u>examined</u>	<u>Attacked by</u>		
		<u>Carpenter-</u> <u>worm</u>	<u>Ash</u> <u>borer</u>	<u>Other</u> <u>borers</u>
		- - - - -	Percent	- - - - -
0-6	24	12.5	58.3	4.2
7-15	24	29.2	58.3	8.3
16-30	26	34.6	50.0	15.4
31+	<u>22</u>	<u>36.4</u>	<u>36.4</u>	<u>54.5</u>
All	96	28.1	51.0	19.8

The presence of *T. bimaculatus* in drier areas of the State and in the oldest trees is significant. Wygant (1938) also found this borer, as well as the carpenterworm, in Nebraska in old trees suffering from lack of moisture. He concluded that while these borers may have contributed to the death of some green ash trees, they were not the primary cause of the decadence of the plantings observed in this period of drought.

Effects of Borers on Windbreaks

Only 1.0 percent of the trees that were dead showed evidence of being killed by borers, and 2.3 percent of the trees showing mortality with subsequent sprouting had been attacked by borers (table 2).

Considering all the trees that were examined, only a small percentage were dead. Borer damage was heaviest in area 54, but only 4.7 percent of the trees were dead and 3.6 percent (table 2) were dead with evidence of being infested by borers at one time. Borers, then, do not seem to be primary tree killers and seldom kill enough trees within a windbreak to reduce its effectiveness.

Damage with sprouting was observed more frequently in area 54 than the other areas. However, in area 54, only about 10 percent of the trees examined had been killed back and sprouts had developed. Of these, 7.9 percent (table 2) had evidence of current or prior borer attack. This does not necessarily represent a loss. There is still a living tree in place, and in many cases, the sprouts have created a more dense barrier than the original tree would have.

Data from area 54 was analyzed to determine if the carpenterworm or the ash borer preferred trees of certain heights or diameters. For windbreaks with two or more infested trees, the mean heights and the

mean diameters of infested and uninfested trees were compared with a "t" test (Snedecor and Cochran 1967, p. 104). The statistical test is of doubtful validity because in most cases only a few infested trees, often only two, were compared with many uninfested trees, often 25 to 40. These data (tables 6 and 7) indicate, although few differences were significant above the 0.10 level, that both borers showed some preference for the larger trees. It is evident that within a given belt, the borers do not necessarily attack the smaller, weaker trees as often supposed.

Table 6.--Height of green ash trees with and without borers in sampled windbreaks in land resource area 54, North Dakota, 1972

<u>Windbreak number</u>	<u>Mean total height</u>		<u>Difference</u>	<u>Borers present</u>
	<u>With borers</u>	<u>Without borers</u>		
- - - - - Feet - - - - -				
AGE CLASS 0-6 YEARS				
54-5	7.2	5.6	<u>1/</u> +1.7	AB
54-6	5.7	5.3	+ .4	AB
54-18	6.6	6.1	+ .5	AB
54-20	5.5	5.0	+ .5	AB
AGE CLASS 7-15 YEARS				
54-12	10.0	10.7	- .7	CW, AB
54-13	14.3	14.3	0	CW, AB
54-17	18.0	14.2	<u>2/</u> +3.7	CW, AB
54-17A	12.8	10.9	<u>1/</u> +2.0	CW, AB
AGE CLASS 16-30 YEARS				
54-3	7.0	8.4	-1.4	AB
54-7	30.1	31.3	-1.1	CW, AB
54-14	15.5	11.6	<u>3/</u> +3.9	CW
54-16	11.5	12.7	-1.2	CW, AB
58-3	19.8	19.0	+ .8	CW
AGE CLASS 31+ YEARS				
54-1	17.0	23.8	<u>2/</u> -6.8	CW
54-15	23.4	18.0	+5.4	CW

1/ Significant at 0.10 level.

2/ Significant at 0.001 level.

3/ Significant at 0.01 level.

Table 7.--Diameters at base of green ash trees with and without borers in sampled windbreaks in land resource area 54, North Dakota, 1972

<u>Windbreak number</u>	<u>Diameters (inches)</u>		<u>Difference (inches)</u>	<u>Borers present</u>
	<u>With borers</u>	<u>Without borers</u>		
AGE CLASS 0-6 YEARS				
54-5	1.70	1.33	<u>1/</u> +0.37	AB
54-6	1.27	1.12	+ .15	AB
54-18	2.00	1.56	+ .44	AB
AGE CLASS 7-15 YEARS				
54-12	2.08	2.24	- .16	CW, AB
54-13	3.33	3.33	0	CW, AB
54-17A	2.96	2.68	+ .28	CW, AB
AGE CLASS 16-30 YEARS				
54-3	1.75	2.13	- .38	CW
54-7	8.63	6.88	+1.75	CW, AB
58-3	6.20	6.14	+ .06	CW
AGE CLASS 31+ YEARS				
54-1	4.98	6.56	<u>2/</u> -1.58	CW

1/ Significant at 0.10 level.

2/ Significant at 0.01 level.

DISCUSSION

The results of this survey indicate that borers are a minor problem at present in green ash in windbreaks within North Dakota. The carpenterworm was found attacking only 7.2 percent of all the trees examined. In area 54, in the southwestern quarter of the State, 23.4 percent of the trees were attacked, but in the other three-quarters of the State damage was negligible. Efforts to develop pest management strategies for carpenterworms should be concentrated in area 54. The percentage of trees attacked by the carpenterworm increased noticeably as the trees became more than 16 years old (table 4).

The ash borer was present in 51 percent of all windbreaks examined and, like the carpenterworm, was most prevalent in area 54. The presence of the ash borer in so many windbreaks should be considered but ash borer damage to these windbreaks was slight.

Ash borers showed a slight preference for trees under 15 years old and were least abundant in trees over 31 years old (table 4). With protection during their younger years, green ash trees could reach an age when ash borers would only be a minor problem.

The problem of borers in green ash windbreaks must be recognized, but it should not limit the planting of this useful and valuable tree in windbreaks. This tree species should be planted wherever it is needed, but with the full realization that management practices will probably include pest control with recommended insecticides or alternative methods to provide adequate protection.

FUTURE STUDIES

There is a need to determine the exact impact borers have on green ash trees within windbreaks. Infestations of both borers should be studied over a considerable period of time. It is suggested that a selected series of plantings infested with carpenterworms and a series infested with ash borers be examined completely each year or every 2 years to evaluate each borer's impact on a long-term basis.

LITERATURE CITED

- Austin, M. E., 1965. Land resource regions and major land resource areas of the United States. USDA, SCS Agr. Handbook 296.
- McKnight, M. E., 1971. Borers in green ash--a problem analysis. USDA, Forest Serv., Shelterbelt Lab., RM Forest and Range Expt. Sta., Bottineau, ND.
- Snedecor, G. W., and W. G. Cochran, 1967. Statistical methods. Sixth ed. Iowa State Univ. Press, Ames, IA, 593 pp.
- Wygant, N. D., 1938. The relation of insects to shelterbelt plantations in the Great Plains. J. Forestry 36: 1011-1018.

